



Programme : B.Sc. Medical Biotechnology

Course Title: Medical Genomics and Proteomics

L	T	P/S	SW/F W	TOTAL CREDIT UNITS
3	0	2	0	4

Course Code: GCMB304

Credit Units: 03+1

Course Objectives:

The course deliberates the students with the detailed structure and function allied to human genome and proteome exploration while appraising the prospects of analytical, statistical and computational techniques applied in accordance with the biomedical research and developments.

Prerequisite : Molecular Biology, Cell Biology, Genetics, Computational Biology and Recombinant DNA technology

Student Learning Outcomes: On completion of the course the students will be able to

- Demonstrate basic genomic and proteomics literacy and understand the factors involved in genomic testing and evaluations.
- Understand and identify genomic tests, their utility and ethical implications with regard to screening, diagnosis and management of disease.
- Constitute and evaluate current methods and techniques within the research field of medical genomics and proteomics

Course Contents/Syllabus- Theory:

	Weightage (%)
Module I	10

<p>Descriptors/Topics: Introduction and Overview: - ‘omes and omics’ Gene, Genome and Genomics - Core Aims of Genome Science and its diversifications, Structural organization of Prokaryotic and eukaryotic genomes; Genome Synteny and Evolution</p>	
<p>Module II</p>	20
<p>Descriptors/Topics: Decoding genomes Sequencing techniques- 1st, 2nd and 3rd generation, Whole Genome Sequencing and reference based assembly: Challenges in de novo sequencing of complex genomes (Human) Vs simple genomes (Haemophilus influenza) : Hierarchical and whole genome shotgun sequencing strategies, finishing – physical and genetic mapping, gaps and their resolution, Genome annotation, Exome Sequencing Human Genome Project - Findings and impact</p>	
<p>Module III</p>	20
<p>Descriptors/Topics: Genomic variations and disease Mapping Monogenic and polygenic disorders - Candidate gene approach, Genome wide association studies, positional cloning, functional cloning; Gene knock out, knock in and knock down; mouse model for human disease; cancer genome atlas Personal Genomics –An introduction to 1000 Genomes Project, Genomics and Precision medicine, Ethical, Legal and Social Implications of Human Genome research Methods of assaying genomic variations – Hybridization (RFLP) and PCR based markers – RAPDs, AFLP, CAPS, SSRs etc; high throughput SNP identification, DNA fingerprinting and its applications</p>	
<p>Module IV</p>	25
<p>Descriptors/Topics: Global Gene Expression Profiling and Analytical Proteomics Transcriptomes, Expression quantification and technologies for transcriptome assembly; RNAseq, Microarray technology - CHIPseq; small RNA therapeutics; Genotype/phenotype association discovery and analysis; Functional genome analysis by random and targeted mutagenesis. Proteome analysis tools (2-D gel electrophoresis); Mass spectrometry (ionization techniques and mass analyzers (ESI, MALDI and Hybrid); LC/MS-MS; Peptide fingerprinting; Implications of PTMs and PMF in disease diagnosis; Structural proteomics principles (NMR, X-Ray); Proteomics experimental workflows; Concepts of protein engineering</p>	
<p>Module V</p>	25

Descriptors/Topics: Proteomic Analysis - Medicine and diagnostics

Shotgun proteomics for proteome profile, Interactomes and relevance of macromolecular complex in disease; Proteomic interactions - experimental and computational methods (in vitro and in vivo approaches); Pharmacogenomics and toxicogenomics; Proteomics in exploratory – Protein networks; Polymorphism, drug metabolism; Proteomics approaches for investigation of therapeutics target discovery; Biomarkers; High throughput screening for drug discovery; Systems biology and disease; Synthetic biology for health

Pedagogy for Course Delivery:**Lectures: 42****Tutorial: 0****Presentation/ Seminar: 1****Class Test: 2 Total:****Lab/ Practical details, if applicable:****Practical: 13****Practical Test: 2****Total: 15****List of Experiments:**

- **Introduction to NCBI and Genome Browsers – UCSC and Ensembl Genome Browser for Eukaryotes and Prokaryotes**
- **Introduction to protein databases – SWISS-PROT, TrEMBL, PDB**
- **Repeat annotation by Repeat Masker**
- **Primer designing using Primer3**
- **Homology Search using BLAST – BLASTn, BLASTp, Psi BLAST**
- **Multiple Sequence Alignment using CLUSTALW and CLUSTALX, Identification of conserved domains**
- **Multiple sequence alignment and phylogeny**
- **An introduction to Gene prediction algorithms – GLIMMER**
- **An introduction to genomic workflows – GALAXY**
- **Translate, SMSuite, MIAME, Melanie, Analysis of 2D- IEF data**
- **Protein Database, SOPMA, GOR 4, Rasmol, THMM, Peptide Cutter, Peptide Mass**
- **Melanie, Flicker, PROFOUND, MASCOT, Alibaba**
- **Metabolic pathways resources: KEGG, Biocarta**
- **Biology workbench**

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	End Term Examination
75	25	100

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop down)	Class test	Assignment	Viva	Attendance	70
Weightage (%)	15	5	5	5	

Lab/ Practical/ Studio Assessment:

Components (Drop down)	Continuous Assessment/Internal Assessment				End Term Examination			
	Class test	Lab record	Viva	Attendance	Performance	Lab Record	Viva	Total
Weightage (%)	10	5	5	5	40	10	20	70

Text & References:

- **Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM & Heyer LJ, Benjamin Cummings 2007; CSH Press, NY. ISBN-10: 8131715590**
- **Principles of Proteomics. R.M Twyman (2004). (BIOS Scientific publishers). ISBN-10: 1859962734**
- **Principles of Genome Analysis and Genomics. Primrose SB & Twyman RM. 2007. Blackwell. ISBN-10: 1405101202**
- **Introduction to Genomics. A.M Lesk, Oxford University press, 2007. ISBN-10: 0199557489**
- **Genome III – T.A. Brown Garland Science Publ. June 08, 2006. ISBN-10: 0815341385**
- **Introduction to Proteomics: Tools for the New Biology. Daniel C. Liebler, Humana Press Inc., 2002. ISBN-10: 0896039919**
- **Bioinformatics and Functional Genomics – Jonathan Pevsner - 2nd edition, Wiley-Blackwell, 2009. ISBN-10: 0471210048**

Any other Study Material:

- **Proteomic to study genes and genomes (2000). Nature 405: 837-846.**
- **Application of DNA microarrays in Biology (2005) Ann. review of Biochemistry 74: 53-82.**
- **Functional Proteomics (2005) Clin Chim Acta 357: 140-150.**
- **Mass spectrometry for proteomics (2008), Curr Opin Chem Biol. Oct;12(5):483-90.**
- **ChIPSeq and beyond – Nature reviews Genetics Volume 13, 2012, 840-852**
- **Sequencing Technologies – The next Generation – Nature reviews Genetics Volume 11, 2010, 31-46**

- **Proteomics: Challenges, Techniques and Possibilities to Overcome Biological Sample Complexity – Human Genomics and Proteomics, 2009.** •
NCBI online tutorials and Videos
- **Genome TV – You tube videos form NIH**